

1 The scientific article you have studied is adapted from the book called The Immortal Life of Henrietta Lacks by Rebecca Skloot, published by Pan Books in 2011.

(a) MPF triggering (paragraph 6) starts the process of mitosis. Suggest **three** events that occur at the beginning of mitosis in a plant cell that may be triggered by MPF.

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(e) Poliovirus, like Human Immunodeficiency Virus, is a retrovirus. Poliovirus was able to infect HeLa cells (paragraph 25).

Give **three** differences between the structure of the genetic material in poliovirus and the genetic material in HeLa cells.

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- (f) Scientists had studied genes by breeding animals 'then breeding their offspring to see how genetic traits are passed from one generation to the next' (paragraph 33).

When this was done using a brown mouse and a white mouse, it was found that in the F₂ generation (second generation of offspring), 75% of the mice were brown.

In the space below, draw genetic diagrams to describe and explain the genotypes of the parents and their offspring in the previous **two** generations.

(4)

(g) Monoclonal antibodies are produced by hybrid cells. These cells are made by fusing a lymphocyte with a cancer cell, such as HeLa (paragraph 37).

Suggest why cancer cells are used to form these hybrid cells.

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(h) Suggest what is meant by the term **genetic engineering** (paragraph 47).

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(i) Place a cross in the box that shows the number of cells present if one cell divided 50 times by mitosis (paragraph 58).

(1)

- A** 2^5
- B** 50^2
- C** 5^{20}
- D** 2^{50}

- (j) Scientists knew that 'there was a string of DNA at the end of each chromosome called a *telomere*' (paragraph 60) and they also knew that 'human cancer cells contain an enzyme called *telomerase*' (paragraph 61).

State **four** chemical elements found in both telomeres and telomerase.

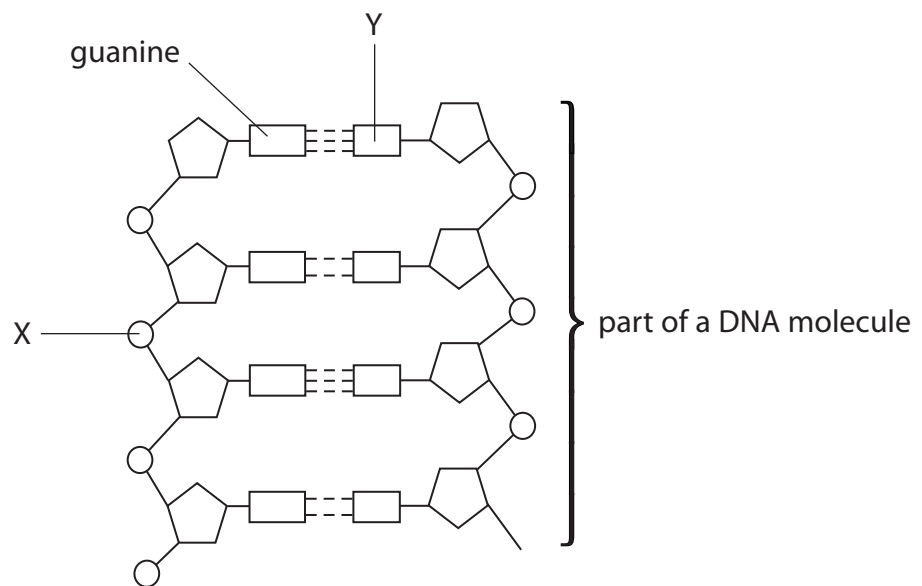
(2)

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(Total for Question 1 = 30 marks)

2 (a) The diagram below shows part of a DNA molecule.



(i) Place a cross ☒ in the box next to the molecule represented by the letter X

(1)

- A** Deoxyribose
- B** Phosphate
- C** Ribose
- D** Uracil

(ii) Place a cross ☒ in the box next to the molecule represented by the letter Y

(1)

- A** Adenine
- B** Cytosine
- C** Thymine
- D** Uracil

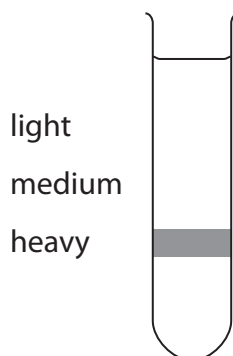
(iii) Place a cross ☒ in the box next to the name of the bonds holding the two strands of DNA together.

(1)

- A** Ester bonds
- B** Glycosidic bonds
- C** Hydrogen bonds
- D** Peptide bonds

(b) A culture of bacteria had its DNA labelled with the heavy isotope of nitrogen (^{15}N).

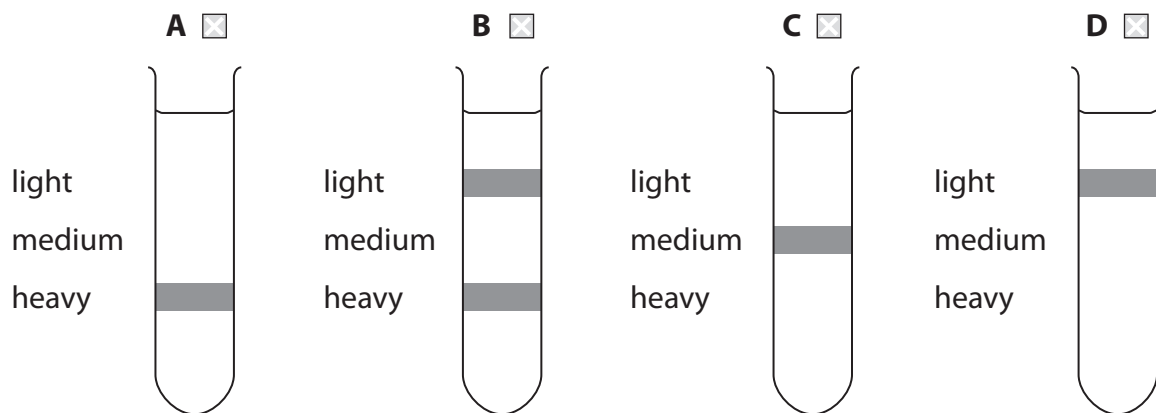
The diagram below shows the position of the DNA band in the centrifuge tube when the DNA was labelled with the heavy isotope of nitrogen, ^{15}N .



The bacterial culture was then allowed to reproduce using nucleotides containing the normal isotope of nitrogen (^{14}N).

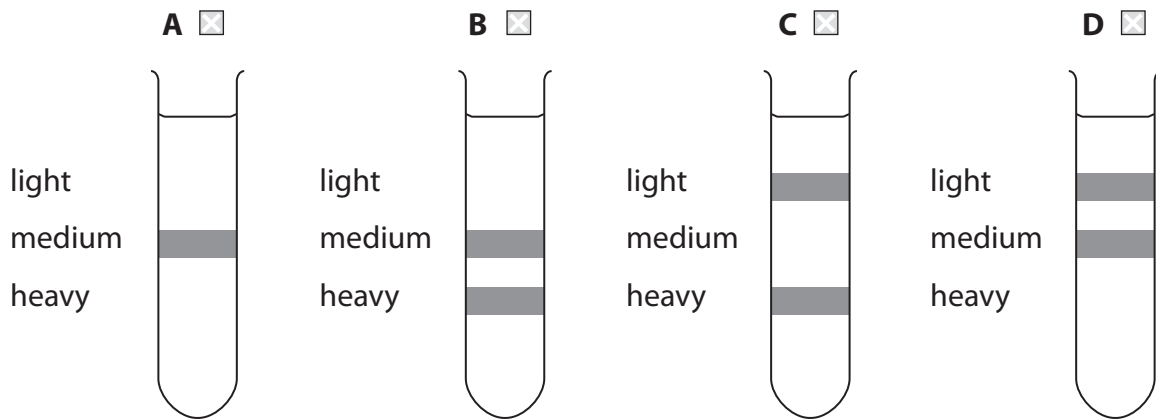
(i) Place a cross in the box below next to the tube showing the correct pattern of DNA after the bacteria have divided once.

(1)



(ii) Place a cross ☒ in the box below next to the tube showing the correct pattern of DNA after the bacteria have divided twice.

(1)



(c) Name the place in a eukaryotic cell where messenger RNA will be synthesised.

(1)

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(d) Achondroplasia is an inherited condition that results in restricted growth in humans. This condition is caused by a dominant allele (A).

Fetuses which are homozygous for the allele for achondroplasia are rarely born alive.

Two parents who both have achondroplasia would like to have children. They are concerned about the risk of their child inheriting two dominant alleles and dying before birth.

(i) Describe **one** advantage and **one** disadvantage to these parents of genetic screening of their fetus.

(2)

Advantage:

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Disadvantage:

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(ii) In the space below, draw a suitable genetic diagram to show the probability of a child from these parents growing up without achondroplasia.

(4)

probability.....

(Total for Question 2 = 12 marks)

3 Cardiovascular disease (CVD) is responsible for many deaths.

*(a) One cause of CVD is atherosclerosis. Describe how atherosclerosis develops.

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(b) A number of factors have been identified that increase the risk of CVD.
One of these factors is genetic.

The genotype of some individuals causes them to be more at risk of developing CVD. One gene that influences this risk is the *KIF6* gene. Carriers of the 719 Arg allele of this gene are more at risk of CVD.

(i) Explain the meaning of the term **genotype**.

(1)

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(ii) Explain the meaning of the term **allele**.

(1)

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(c) Give **two** factors, other than genetic factors, that increase the risk of developing CVD.

(1)

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(d) Trials have shown that plant statin therapy is more effective in 719 Arg carriers than in non-carriers of this allele.

Describe the risks of using plant statins to treat CVD.

(2)

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(Total for Question 3 = 9 marks)
